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(21)Application number : 2001- (71)Applicant : RICOH CO LTD  
085890

(22)Date of filing : 23.03.2001 (72)Inventor : KANEKO TETSUYA  
ARITA HITOSHI  
NAGAI KIYOFUMI  
MURAKAMI KAKUJI

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(54) AQUEOUS RECORDING LIQUID METHOD AND DEVICE FOR RECORDING USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an aqueous recording liquid forming an improved image excellent in permeability and dryness regardless of a coloring agent and the kinds of paper and blurred very little.

SOLUTION: This liquid contains a coloring matter 224-trimethyl-13-pentanediole polyoxyethylene alkyl ether surfactant (1):  $R1O(CH_2CH_2O)_pH$  (R1 is an 8-14C alkyl group which may be branched p is 1-30) and/or a polyoxyethylene alkyl ether acetate surfactant (2):

$R2O(CH_2CH_2O)_qCH_2COOM$  (R2 is an 8-14C alkyl group which may be branched; q is 3-8; M is an alkali metal ion or a quaternary ammonium quaternary phosphonium or alkanolamine).

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### CLAIMS

[Claim(s)]

[Claim 1] An aqueous recording liquid containing a color material 224-trimethyl 13-pentanediole and a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent.

[Claim 2]The aqueous recording liquid according to claim 1 wherein a polyoxyethylene-alkyl-ether surface-active agent is shown with a following general formula (1) in said aqueous recording liquid.  
[Chemical formula 1]

(R<sub>1</sub> is an alkyl group of the carbon numbers 8-14 which may branch among (1) type.) p expresses an integer of 1 to 30.

[Claim 3]The aqueous recording liquid according to claim 1 or 2 wherein a polyoxyethylene-alkyl-ether acetate surface-active agent is expressed with a following general formula (2) in said aqueous recording liquid.  
[Chemical formula 2]

(R<sub>2</sub> is an alkyl group of the carbon numbers 8-14 which may branch among (2) types.) q expresses an integer of 3 to 8 and M expresses alkali metal ion or the 4th class ammonium the 4th class phosphonium and alkanolamine.

[Claim 4]An aqueous recording liquid given in any 1 clause of 1 to 3 to which content of 224-trimethyl land 3-pentanediol is characterized by being 8 or less weight % 0.1 weight % or more.

[Claim 5]The aqueous recording liquid according to any one of claims 1 to 3 to which a total content of a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent is characterized by being 4 or less weight % 0.01 weight % or more.

[Claim 6]Content of 224-trimethyl land 3-pentanediol is 8 or less weight % of 0.1 weight % or more And the aqueous recording liquid according to any one of claims 1 to 3 to which a total content of a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent is characterized by being 4 or less weight % 0.01 weight % or more.

[Claim 7]In an aqueous recording liquid glycerinethylene glycola diethylene glycol Triethylene glycol propylene glycol diisopropylene glycol Tripropylene glycol 13-butanediol 23-butanediol 14-butanediol 15-pentanediol tetraethylene glycol 16-hexanediol the 2-methyl-24-pentanediol A polyethylene glycol 124-butanetriol 126-hexanetriol Thiodiglycol 2-pyrrolidone N-methyl-2-pyrrolidone The aqueous recording liquid containing at least one or more water soluble organic solvents chosen from an N-hydroxyethyl 2-pyrrolidone and 13-dimethyl-2-imidazolidinone according to any one of claims 1 to 6.

[Claim 8]The aqueous recording liquid according to any one of claims 1

to 7 wherein color materials are paints.

[Claim 9] The aqueous recording liquid according to claim 8 being a range whose mean particle diameter of paints is 10 nm - 200 nm.

[Claim 10] The aqueous recording liquid according to claim 8 or 9 characterized by coming to distribute paints underwater with a dispersing agent which has a carboxyl group.

[Claim 11] The aqueous recording liquid according to claim 8 or 9 characterized by a hydrophilic group's combining with paints by surface treatment and coming to distribute these paints underwater.

[Claim 12] The aqueous recording liquid according to claim 11 wherein a hydrophilic group combined with the paints surface is a carboxyl group.

[Claim 13] A record method which makes regurgitation the aqueous recording liquid according to any one of claims 1 to 12 and is characterized by making it disperse and forming a picture in a recording medium as droplet from a detailed delivery.

[Claim 14] The record method according to claim 13 wherein said record method makes thermal energy act on an aqueous recording liquid and forms a picture in a recording medium.

[Claim 15] The record method according to claim 13 or 14 which a recording medium uses a pulp fiber as the main ingredients and is characterized by being more than size degree 10S and the air permeability 5-50S.

[Claim 16] The record method according to claim 15 wherein the discharge quantity  $V$  (pl) per [ which is breathed out from a recording head ] drop satisfies the following formula (3).

$2.5 \times 10^8 / R^{2.6} < V < 6.0 \times 10^8 / R^{2.6}$  .... (3) (here  $R$ ) A pulp fiber is used as the main ingredients the maximum placing density of droplet when recording to a recording medium which are more than size degree 10S and the air permeability 5-50S is shown and it expresses with unit dpi (= DotPerInch).

[Claim 17] In [ make two or more aqueous recording liquids into droplet from a same or separate delivery so that at least a part of picture element region may lap on a recording medium and ] regurgitation and a record method which makes it disperse and forms a picture in a recording medium The record method according to any one of claims 13 to 16 wherein a discharge time difference of two aqueous-recording-liquid droplets which produce a lap on a recording medium is 0.125 millisecond or less.

[Claim 18] A recording fluid cartridge characterized by said aqueous recording liquid being the aqueous recording liquid according to any one of claims 1 to 12 in a recording fluid cartridge provided with a recording ink seat part which accommodated an aqueous recording liquid.

[Claim 19] A recording ink seat part which accommodated an aqueous

recording liquid.

A head section for making aqueous-recording-liquid droplet breathe out. It is the recording fluid cartridge provided with the above and is characterized by said aqueous recording liquid being the aqueous recording liquid according to any one of claims 1 to 12.

[Claim 20] A recording ink seat part which accommodated an aqueous recording liquid.

A recording fluid cartridge which has a recording head for making aqueous-recording-liquid droplet breathe out.

It is the ink-jet recording device provided with the above and Claim 18 or a recording fluid cartridge of 19 was provided.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] The aqueous recording liquid to which this invention was suitable for ink jet recordings such as continuous injection method, such as the methods on demand, such as a piezo system and a thermal system, and an electrification control system. It is an aqueous-recording-liquid constituent in which the characteristic outstanding to especially a regular paper what is called is shown -- aqueous writing materials, a recorder, and a pen plotter -- service water -- it is used also as sex recording ink.

[0002]

[Description of the Prior Art] The main part of an ink jet recording method is small and its price is cheap and in recent years low running cost. From the advantage of a low noise, have spread through urgency and in recent years. The transfer paper for electrophotography. The ink-jet printer usually printable on paper which are various non-coat, such as a print sheet, a typewriter paper, a stylus printer paper, a word processor paper, a letter paper, and writing paper is also thrown into the commercial scene. In these ink jet printers, the proposal of the ink which has improved drying property so that a more nearly high-definition picture may be acquired is made.

[0003] However, it is difficult to satisfy the color reproduction nature of a picture, a water resisting property, light fastness, the drying property of a picture, blots of a picture, and all the reliability of the droplet

regurgitation. Even if it is a case where image quality deterioration is not accepted in yellowmagentaand the monochrome printing unit of cyanogen especially in the case of a color printerit is easy to generate degradation of image quality in redgreenand 2 blue color pile portions. When drying without using especially an anchorage devicedrying property was improved by improving perviousness like JPS55-29546Abut [ therefore ] the tendency which produces a blot remarkably was on paper. If dialkyl sulfosuccinate is used as a surface-active agentdrying property improvesand image deterioration is lessenedbut the pixel diameters in paper differ in JPS60-23793B remarkablyand the fall of image density also has the problem that it is remarkable in it. JPS58-6752B has disclosed quick drying ink with few blots by what perviousness is raised for using the surface-active agent with which the ethyleneoxide which has an acetylenic linkage was added. [0004]Howeverthe following problems are produced depending on colorant. For example the problem that a drying rate does not improve since \*\*\*\* for ink containing the substantivity color of DBK168 gradeand colorant and a hydrophobic interaction are produced arisesOr if the ink containing paintssuch as carbon blackis usedit will be easy to condense paintsand the problem of being easy to generate blinding of a nozzlea bend of the direction of ink jetetc. arises. In order to improvesimilarly a drying rate to JPH8-113739A. The ink containing a color and water-soluble glycol ether is proposedand paintsand glycol ethersuch as diethylene-glycol mono-n-butyl etherand the ink composition which consists of water further are proposed by JPH10-95941A. Howeverin order to improve a drying ratea lot of glycol ether needs to be addedand it is not preferred from the bad smell of inkor the field of safety. Although the ink which adds a strong base nature substance is indicated by JPS56-57862Aand degradation of image quality is not accepted in the acid paper by which rosin size was carried outthere is no effect in the paper which used an alkyl ketene dimer and alkenyl sulfosuccinic acid as the sizing compound. Also in acid paperdegradation of image quality is accepted in 2 color pile portions. The aquosity recording ink which consists of water soluble dyewaterand benzyl ether of specified structure is proposed by JPH2-138374A. In order to raise the perviousness of ink furtherin it Oilsuch as vegetable oilunsaturated fatty acidhigher alcoholfatty acid esterand mineral oilHave a hydroxyl group in intramolecular and as a solvent of poor solubility or fine solubility in water 2-ethyl-16-hexanediolAlthough adding diethylene-glycol hexyl etherthe ethyleneoxide addition (the five (or less) number of addition mols) of an acetylene glycolethylene glycol benzyl etheretc.

is proposed As for these ink there was a problem in safety further with environmental temperature coil damage-at-sea solubility and a fine solubility solvent benzyl ether etc. dissociated and stability had a very big problem. It is a constituent which contains a pigment and a liquid medium in the patent No. 2894568 and the ink for ink jets which contains alkylene glycol of 60 weight % or more and the carbon numbers 7-10 for water 0.2 to 30 weight % in said liquid medium is proposed. As a desirable example of this "alkylene glycol of the carbon numbers 7-10" 1,7-heptane diol 2,6-heptane diol 2,4-dimethyl- 2,4-pentanediol the 3-ethyl- 1,3-pentanediol etc. are illustrated. Although it carries out "usually improving a blot of ink in the paper drying property and perviousness" by including these compounds in ink and "balance's taking at the point of a blot and perviousness" and ink "reliable also in blinding tightness" can be provided By addition of these illustration compound SUBJECT from the former -- the pervious improvement of ink is insufficient and therefore drying property is low and it is easy to generate a blot depending on a paper type -- was not actually solved at all. The ink jet ink which contains the aliphatic series diol compound of specified structure which has at least six carbon atoms and has the solubility of at least 4.5 weight sections in water 100 25 \*\* weight section in the patent No. 2714482 is proposed. As these diol compounds 2-ethyl- 2-methyl- 1,3-propanediol 3,3-dimethyl- 1,2-butanediol 2,2-diethyl- 1,3-propanediol Although 2-methyl- 2-propyl- 1,3-propanediol 2,4-dimethyl- 2,4-pentanediol 2,5-dimethyl- 2,5-hexane-diol 5-hexene-1,2-diol etc. are illustrated The ink which added any cannot obtain sufficient perviousness either but produces color bleeding and feathering.

[0005] Then in JPB6-157959A these people proposed the 2-ethyl- 1 the aqueous ink which added 3-hexandiols and the record method using it in order to improve perviousness. In the above-mentioned patent No. 2894568 the 2-ethyl- 1 of this invention and 3-hexandiols are not only illustrated as a compound but are wholeheartedly found out by this invention person out of a variety of compounds after examination. By this satisfy the various characteristics as ink jet ink and Perviousness The aqueous ink composition in which it excelled in drying property and image quality deterioration was improved can be provided The record method for carrying out image formation good using this ink composition could be provided the jetting stability of the high frequency drive was acquired with a little additions and the record method using ink with high safety was able to be provided.

[0006] however saying [ that the output speed of an ink jet printer will become increasingly quick and the further improvement in the speed will

progress by progress of dizzy technology in recent years from now on also ] --- imagination --- not being hard . Drying immediately is called for without soiling fingerseven if it is under such a situationand ink does not cause color bleeding in much more high speed printing but it rubs after printing.

[0007]Generallywhile drying high ink raises the perviousness to paperwhen colorant trespasses upon the thickness direction of paperit has the fault of reducing image density and increasing strike-through concentration. The aqueous ink with few strike-throughs which it is in \*\* that double-sided printing becomes indispensableare one side of high drying propertyand especially make double-sided printing possible further from development of an ink jet printer and a point of paper consumption as an environmental problem is called for. Thusdevelopment of the aqueous ink jet ink in which the various characteristics as ink jet ink were satisfiedand it was not concerned with the colorant kind or the paper typebut excelled in perviousness and drying propertyand image quality and a strike-through were improved even now is still called for. [0008]In recent years the system is also put in practical use by reading recorded information by infrared rays or ultraviolet raysusually being unable to recognize visually in fields such as postmark printing of bar code printingmailetc. Though it is aqueous in order to consider aqueous-ization and for the recording ink used for these to also correspond to high speed processing indispensable to such a system from a point of environmental pollutionthe recording ink of a hypertonicity is needed.

[0009]

[Problem to be solved by the invention]This invention is made in view of such a problem and there is a place made into the purpose in providing the apparatus using the ink jet recording method using the recording ink and this which conquered the problem of the conventional technology mentioned above and the recording ink to apply.

[0010]

[Means for solving problem]In order to attain this purposeinvention of the aqueous recording liquid according to claim 1A color material2,4-trimethyl 13-pentanedioland a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent are contained.

[0011]A polyoxyethylene-alkyl-ether surface-active agent is shown [ in / on an aqueous recording liquid of Claim 1 and / in the invention according to claim 2 / an aqueous recording liquid ] by following general formula (1).

$R_1O(CH_2CH_2O)_pH \dots (1)$

( $R_1$  is an alkyl group of the carbon numbers 8-14 which may branch among (1) type.)  $p$  expresses an integer of 1 to 30.

[0012] A polyoxyethylene-alkyl-ether acetate surface-active agent is expressed [ in / on Claim 1 or an aqueous recording liquid of 2 and / in the invention according to claim 3 / an aqueous recording liquid ] with a following general formula (2).

[0013]

[Chemical formula 3]

[0014] ( $R_2$  is an alkyl group of the carbon numbers 8-14 which may branch among (2) types.)  $q$  expresses an integer of 3 to 8 and  $M$  expresses alkali metal ion or the 4th class ammonium the 4th class phosphonium and alkanolamine.

[0015] The invention according to claim 4 is characterized by the content of 2,2,4-trimethyl 1,3-pentanediol being 8 or less weight % of 0.1 weight % or more in one aqueous recording liquid of 3 from Claim 1.

[0016] The invention according to claim 5 is characterized by the total content of a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent being 4 or less weight % of 0.01 weight % or more in the aqueous recording liquid according to any one of claims 1 to 3.

[0017] The invention according to claim 6 is boiled and set and 0.1 weight % or more the content of the aqueous recording liquids 2 and 2 according to any one of claims 1 to 3 4-trimethyl 1,3-pentanediol is 8 or less weight % and the total content of a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent is characterized by being 4 or less weight % 0.01 weight % or more.

[0018] In the aqueous recording liquid according to any one of claims 1 to 6 the invention according to claim 7 in an aqueous recording liquid glycerin ethylene glycol diethylene glycol triethylene glycol propylene glycol dipropylene glycol tripropylene glycol 1,3-butanediol 2,3-butanediol 1,4-butanediol 1,5-pentanediol tetraethylene glycol 1,6-hexanediol the 2-methyl- 2,4-pentanediol A polyethylene glycol 1,2,4-butanetriol 1,2,6-hexanetriol At least one or more water soluble organic solvents chosen from thiodiglycol 2-pyrrolidone N-methyl-2-pyrrolidone N-hydroxyethyl 2-pyrrolidone and 1,3-dimethyl-2-imidazolidinone are contained.

[0019] The invention according to claim 8 is characterized by color

materials being paints in the aqueous recording liquid according to any one of claims 1 to 7.

[0020]The invention according to claim 9 is characterized by being a range whose mean particle diameter of paints is 10 nm - 200 nm in the aqueous recording liquid according to claim 8.

[0021]It comes for paints to be underwater distributed by dispersing agent with which the invention according to claim 10 has a carboxyl group in the aqueous recording liquid according to claim 8 or 9.

[0022]In the aqueous recording liquid according to claim 8 or 9a hydrophilic group combines the invention according to claim 11 with paints by surface treatment and it comes to distribute paints underwater.

[0023]The invention according to claim 12 is characterized by a hydrophilic group combined with the paints surface being a carboxyl group in the aqueous recording liquid according to claim 11.

[0024]From a detailed delivery as droplet invention of the record method according to claim 13 makes regurgitation the aqueous recording liquid according to any one of claims 1 to 12 and is characterized by making it disperse and forming a picture in a recording medium.

[0025]In a record method of Claim 13a record method makes thermal energy act on an aqueous recording liquid and the invention according to claim 14 forms a picture in a recording medium.

[0026]In Claim 13 or a record method of 14a recording medium uses a pulp fiber as the main ingredients and the invention according to claim 15 is characterized by being more than size degree 10S and the air permeability 5-50S.

[0027]The discharge quantity  $V$  (pl) per [ by which the invention according to claim 16 is breathed out from a recording head in a record method of Claim 15 ] drop satisfies the following formula (3).  
$$2.5 \times 10^6 / R^2 \leq V \leq 6.0 \times 10^6 / R^2 \dots (3) \text{ (here } R \text{)}$$
A pulp fiber is used as the main ingredients the maximum placing density of droplet when recording to a recording medium which are more than size degree 10S and the air permeability 5-50S is shown and it expresses with unit dpi (= DotPerInch).

[0028]In one record method of Claim 13 to 16 the invention according to claim 17 In [ make two or more aqueous recording liquids into droplet from a same or separate delivery so that at least a part of picture element region may lap on a recording medium and ] regurgitation and a record method which makes it disperse and forms a picture in a recording medium It is characterized by a discharge time difference of two aqueous-recording-liquid droplets which produce a lap on a recording medium being 0.125 millisecond or less.

[0029]In a recording fluid cartridge provided with a recording ink seat

part which accommodated an aqueous recording liquid invention of the recording fluid cartridge according to claim 18 is characterized by an aqueous recording liquid being the aqueous recording liquid according to any one of claims 1 to 12.

[0030] In a recording fluid cartridge provided with a recording ink seat part which accommodated an aqueous recording liquid and a head section for making aqueous-recording-liquid droplet breathe out invention of the recording fluid cartridge according to claim 19 is characterized by an aqueous recording liquid being the aqueous recording liquid according to any one of claims 1 to 12.

[0031] Invention of the ink-jet recording device according to claim 20 In an ink-jet recording device provided with a recording fluid cartridge which has a recording ink seat part which accommodated an aqueous recording liquid and a recording head for making aqueous-recording-liquid droplet breathe out Claim 18 or a recording fluid cartridge of 19 was provided.

[0032]

[Mode for carrying out the invention] In order to solve an aforementioned problem an aqueous recording liquid of this invention comprises the following:

A color material.

224-trimethyl 13-pentanediol.

A polyoxyethylene-alkyl-ether surface-active agent or/and a polyoxyethylene-alkyl-ether acetate surface-active agent.

[0033] A polyoxyethylene-alkyl-ether surface-active agent and a polyoxyethylene-alkyl-ether acetate surface-active agent have the following structures preferably. That is a polyoxyethylene-alkyl-ether system surface-active agent is shown by the following general formula (1).

$R_1O(CH_2CH_2O)_pH \dots (1)$

( $R_1$  is an alkyl group of the carbon numbers 8-14 which may branch among (1) type.)  $p$  expresses the integer of 1 to 30.

[0034] A polyoxyethylene-alkyl-ether acetate system surface-active agent is shown by the following general formula (2).

[0035]

[Chemical formula 4]

[0036] ( $R_2$  is an alkyl group of the carbon numbers 8-14 which may branch among (2) types.)  $q$  is an integer of 3 to 8 and  $M$  expresses alkali metal

ionthe 4th class ammoniumthe 4th class phosphoniumor alkanolamine.  
[0037]The recording ink of this invention is excellent in preservation stabilityand is not based on a paper typebut the wettability of the recording ink to a paper face and its infiltration speed to paper are highand there is very little image deterioration compared with the recording ink which improved perviousness which is known further conventionally. Outstanding jetting properties are shown without producing nozzle pluggingwhen it uses for an ink jet recording method. Such outstanding character can be obtained in combination with various color materials. General formula (1) About the compound which forms a salta free acid type shows below the example of a compound expressed with -- (2).

[0038]Firstas a compound expressed with a general formula (1)it is following general formula (1-1) - (1-13).

[0039]

[Chemical formula 5]

[0040]Although \*\* is mentionedit is not limited to these. These may be used independentlyor two or more sorts may be mixed and used for them. If independenteven if it is a case where it does not dissolve easily in recording inkit is solubilized by mixing and can exist stably.

[0041]BT series; more nearly available than Nikko ChemicalsInc. as what contains this compound as the main ingredients with a commercial surface-active agent -- SOFUTA Norian series; more nearly available than NIPPON SHOKUBAI Co.Ltd. -- surface-active agentssuch as DISUPA Norian more nearly available than Nippon Oil & Fats Co.Ltd. are mentionedand it is used suitably.

[0042]Nextas a compound expressed with a general formula (2)it is following general formula (2-1) - (2-13).

[0043]

[Chemical formula 6]

[0044]Although \*\* is mentionedit is not limited to these. These may be used independentlyor two or more sorts may be mixed and used for them. If independenteven if it is a case where it does not dissolve easily in recording inkit is solubilized by mixing and can exist stably. As for the mineral salt generated as a by-product at the time of compositionit is preferred to carry out refining removal with ion-exchange resin.

[0045]the NIKKOLECT series more nearly available than Nikko ChemicalsInc.

as what is a commercial surface-active agent and contains this compound as the main ingredients and NIKKOLAKYPO series; Mitsuhiro -- surface-active agentssuch as view light series more nearly available than Transformationare also usable.

[0046]The polyoxyethylene-alkyl-ether acetate surface-active agent expressed with said general formula (2) is usually used in the form of a salt and alkali metal ion or the 4th class ammoniumthe 4th class phosphoniumand alkanolamine are preferred as the counter ion. When each positive ion of the 4th class ammoniumthe 4th class phosphoniumand alkanolamine which are expressed with a sodium positive iona lithium positive ionand/or a following general formula (4) is used as a counter ion solution stability increases further and it is still more desirable.

[0047]

[Chemical formula 7]

[0048](Y expresses nitrogen or a phosphorus among (4) types and  $R_1 - R_4$  express a hydrogen atom an alkyl group of the carbon numbers 1-4a hydroxyalkyl group and an alkyl halide group respectively.)

[0049]For example when a polyoxyethylene-alkyl-ether acetate surface-active agent is lithium salt it is prepared by adding lithium hydroxide and when it is a salt with the 4th class ammonium of a general formula (4) phosphonium and alkanolamine it is prepared by adding hydroxide specifically shown below.

[0050]

[Chemical formula 8]

[0051]Each may be independently used for a polyoxyethylene-alkyl-ether surface-active agent and a polyoxyethylene-alkyl-ether acetate surface-active agent or it may mix and it may be used for them.

[0052]Recording ink of this invention with a polyoxyethylene-alkyl-ether surface-active agent or a polyoxyethylene-alkyl-ether acetate surface-active agent. By using 2,2,4-trimethyl land 3-pentanediol without having very high perviousness and dissociating in liquid it is stable and recording ink whose safety is still higher can be obtained.

[0053]Although it is not yet clear about an operation of a polyoxyethylene-alkyl-ether surface-active agent used for an aqueous recording liquid of this invention a polyoxyethylene-alkyl-ether acetate surface-active agent 2 and 2,4-trimethyl land 3-pentanediol it is guessed as follows.

[0054] On molecular structure it is unsymmetrical and since they have branching structure they tend to adsorb water on the surface of colorant in recording ink used as the main ingredients and since 224-trimethyl and 3-pentanediol have the comparatively small molecular weight compared with what is called a surface-active agent an adsorption rate to the surface is remarkably high [pentanediol]. That is surface tension of a liquid can be promptly reduced like a surface-active agent because 224-trimethyl and 3-pentanediol adsorb on the surface of colorant. However 224-trimethyl and 3-pentanediol had to be added so much in order to obtain high perviousness only by 224-trimethyl and 3-pentanediols since hydrophilic nature and the hydrophobic difference are small compared with a surface-active agent. Recording ink which added 224-trimethyl and 3-pentanediol so much had problems such as adsorption to safety phase separation and colorant and condensation and was not preferred.

[0055] Although it is known that a polyoxyethylene-alkyl-ether surface-active agent or a polyoxyethylene-alkyl-ether acetate surface-active agent will also lower surface tension and will raise perviousness on the other hand the adsorption rate to the surface of colorant was not necessarily high and was not able to obtain sufficient perviousness from the size of surfactant molecules or its form.

[0056] Then if 224-trimethyl 13-pentanediol a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent are used together it found out that the remarkable high osmosis characteristic was obtained by very little use by a synergistic effect and resulted in this invention. 224-trimethyl and 3-pentanediol are useful materials industrially and since it is treated comparatively in large quantities they also have comparatively the advantage that manufacture of recording ink is possible by low cost. The addition in recording ink is explained.

[0057] It is preferred that the additions of a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent are 0.01 weight % or more and 4 weight % or less to the recording ink whole quantity. An improvement of perviousness is insufficient in an addition being less than 0.01 weight % to the recording ink whole quantity and on the other hand if more than 4 weight % since [which is not stably dissolved into recording ink] viscosity becomes high even if it sake or dissolves a problem will be produced at the preservation stability of recording ink and the injection stability in an ink jet.

[0058] An addition of a still more desirable polyoxyethylene-alkyl-ether

surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent is 2 or less weight % of 0.05 weight % or more. [0059] 0.1 weight % or more and 8 weight % or less have a preferred addition of 224-trimethyl land 3-pentenediol to the recording ink whole quantity. Improving this addition perviousness becomes being less than 0.1 weight % insufficient to the recording ink whole quantity if more than 8 weight % it will not dissolve stably in recording ink but a problem will be produced at the preservation stability of recording ink and injection stability in an ink jet. As for 224-trimethyl land 3-pentenediol it is preferred more preferably that it is the 0.5 weight % or more 5 or less weight % of addition.

[0060] 224-trimethyl land 3-pentenediol have low solubility to water and when it is independently added in recording ink an environmental condition is easy to separate them. However stable recording ink can be obtained because a polyoxyethylene-alkyl-ether system surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent compatibility-ize 224-trimethyl 13-pentenediol.

[0061] Mixing with not only the stability of recording ink but 224-trimethyl 13-pentenediol a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent demonstrates a synergistic effect. Compared with recording ink which contained each independently high perviousness can be obtained by a little addition. That is since an effect is acquired in the state with few additions to inside of recording ink compared with recording ink which added ether of conventional polyhydric alcohol etc., so much and raised perviousness there is also an advantage like there are few solvent smells and the safety of recording ink itself is also high.

[0062] Are a constituent which contains a pigment and a liquid medium in the patent No. 2894568 and although ink for ink jets contained 0.2 to 30 weight % is proposed [alkylene glycol / of 60 weight % or more and the carbon numbers 7-10] in water in said liquid medium. Even if it is alkylene glycol of the carbon numbers 7-10 it is clear to produce a big difference in compatibility over water of the compound and the perviousness of ink containing them with a connecting position or a carbon number of a hydroxyl group.

[0063] 2 by this invention 24-trimethyl land 3-pentenediol. In the patent No. 2894568 by this invention person it is not only illustrated as a compound but, it is wholeheartedly found out out of various compounds after examination. This invention which combined 224-trimethyl 13-pentenediol a polyoxyethylene-alkyl-ether system surface-active agent and/or a polyoxyethylene-alkyl-ether acetate system surface-active

agent if it is "alkylene glycol of the carbon numbers 7-10" compared with the patent No. 2894568 to validate a difference of an effect will clear-- come out in respect of a blot of the perviousness of ink or a picture. [0064] Give thermal energy to ink in order to acquire a jetting stability from micropore in record methods which record by making ink breathe out as droplets such as what is called a bubble thermal system etc. a method of adding 2-propanol is known for the former but. By replacing with 2-propanol and adding 2,2,4-trimethyl and 3-pentanediol a wettability to a thermal element is improved a jetting stability and frequency stability are acquired also with a little addition and a problem about safety accompanying use of 2-propanol is also solved.

[0065] This invention person found out that the effect which was excellent when preventing a strike-through with improvement in image density was acquired when 2-pyrrolidone was added to recording ink. This is containing 2-pyrrolidone and since recording ink is damp it becomes easy to spread to a paper face and osmosis in the thickness direction of paper is suppressed relatively it is conjectured to be because it to become easy to remain colorant near the paper face. As for the addition of 2-pyrrolidone it is preferably desirable that they are 0.5 weight % - 4 weight % still more preferably 0.05 weight % - 8 weight %.

[0066] Furthermore this invention person by adding a wetting agent 5 weight % - 50 weight % in order to improve the solution stability of prevention of blinding by desiccation of recording ink and the recording ink of this invention to the recording ink of this invention in the delivery of an ink jet head. Since it was hard to produce blinding even when the moisture in recording ink evaporates even if normal printing could be performed and it caused blinding it found out that it was recoverable to a normal printing condition by easy cleaning operation. As a wetting agent a low volatility water soluble organic solvent is preferred.

[0067] A low volatility water soluble organic solvent is an ingredient (B) (a polyoxyethylene-alkyl-ether surface-active agent and/or a polyoxyethylene-alkyl-ether acetate surface-active agent.) of this invention, hereafter the same -- and an ingredient (A) (2,2,4-trimethyl 1,3-pentanediol.) The preservation stability of recording ink and injection stability can be further improved by working as a dissolution auxiliary agent [ that it is the same ] hereafter.

[0068] As a low volatility water soluble organic solvent ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, tripropylene glycol, polyethylene glycol, A polypropylene glycol, 1,3-butanediol, 2,3-butanediol, 1,4-butanediol, 1,5-

pentanediol the 2-methyl- 2,4-pentanediol 1,6-hexanediol glycerin 1,2,6-hexanetriol Polyhydric alcohol classes such as 1,2,4-butanetriol 1,2,3-butanetriol and all [ PETROL ] Ethylene glycol monoethyl ether ethylene glycol monobutyl ether Diethylene glycol monomethyl ether diethylene glycol monoethyl ether Diethylene-glycol monobutyl ether tetraethylene glycol monomethyl ether Polyhydric alcohol aryl ether; 2-pyrrolidone such as polyhydric alcohol alkyl ethers such as propylene glycol monoethyl ether ethylene glycol monophenyl ether and ethylene glycol monobenzyl ether N-methyl-2-pyrrolidone an N-hydroxyethyl 2-pyrrolidone Nitrogen-containing heterocyclic compounds such as 1,3-dimethyl

IMIDAZOLINONE N-epsilon caprolactam and gamma-butyrolactone; A formamide Amides such as N-methylformamide and N,N-dimethylformamide; Monoethanolamine They are sulphur-containing compounds such as amines such as diethanolamine triethanolamine monoethyl amine diethylamine and triethylamine dimethyl sulfoxide sulfolane thiodiethanol and thiodiglycol propylene carbonate ethylene carbonate etc. One or more sorts are mixed in water and these solvents are used for it.

[0069] Glycerin from a point of compatibility with an ingredient (B) and an ingredient (A) ethylene glycol A diethylene glycol triethylene glycol propylene glycol Dipropylene glycol tripropylene glycol 1,3-butanediol 2,3-butanediol 1,4-butanediol 1,5-pentanediol Tetraethylene glycol 1,6-hexanediol the 2-methyl- 2,4-pentanediol A polyethylene glycol 1,2,4-butanetriol 1,2,6-hexanetriol thiodiglycol 2-pyrrolidone N-methyl-2-pyrrolidone an N-hydroxyethyl 2-pyrrolidone and 1,3-dimethyl-2-imidazolidinone are preferred. It is preferred especially to use glycerin and a diethylene glycol from points such as safety and a price independent or mixing.

[0070] 50 or less weight % of 5 weight % or more is desirable still more preferred as mentioned above and an addition of these low volatility water soluble organic solvent in inside of a recording ink constituent is 30 or less weight % of 8 weight % or more. An addition of a low volatility water soluble organic solvent in less than 5 weight %. Moisture evaporation depressor effect in recording ink is insufficient and A polyoxyethylene-alkyl-ether surface-active agent in recording ink Depending on content of a polyoxyethylene-alkyl-ether acetate surface-active agent 2 and 2,4-trimethyl 1 and 3-pentanediol it becomes insufficient [ an effect as a dissolution auxiliary agent ] and faults such as spoiling the preservation stability of recording ink and injection stability is produced. On the contrary when it adds more mostly than 50 weight % compared with the time of an addition in a mentioned range injection stability in an ink jet by rise of viscosity is

inferior and there is a problem that a cockring of a picture part after printing gets worse further. In order to obtain high definition with an ink jet recording method regulation of the wettability of recording ink to a component which constitutes an ink jet head is important. Therefore it is also possible to add a surface-active agent further to recording ink of this invention because of wettable regulation etc. [0071] As such a surface-active agent for example Anionic surface-active agentssuch as ammonium salt of polyoxyethylene alkyl ether sulfate Ampholytic surface active agentssuch as cation system surface-active agentssuch as quarternary ammonium salt and an imidazoline derivative Polyoxyethylene alkyl phenyl ether polyoxyethylene alkyl ester The Nonion system surface-active agentssuch as polyoxyethylene alkylamine polyoxyethylene alkylamide a sorbitan fatty acid ester polyoxyethylene sorbitan fatty acid ester and an ethyleneoxide additive of acetylene alcohol a fluorochemical surfactant etc. are mentioned. As for these surface-active agents it is desirable to be added so that it may become the physical properties of a request of recording ink.

[0072] The color material used for this invention consists of paints and/or a color. The color classified into acid dye a substantivity color a basic stain reactivity and the food color in a Color Index as water soluble dye used as a color material is used. These colors may mix and use two or more kinds or if needed it may mix with other pigmentssuch as paints and they may use them. These color materials can be added in the range which does not bar the effect of this invention.

[0073] If these colors are mentioned concretely As acid dye and the food color. C. The I. acid yellow 172342 and 44 the 79142C. I. acid red 181314182627353742528287899297106111114115134 and 186249254289C. The I. acid blues 929 and 45 the 92249C. I. acid blacks 12724 and 26 the 94C. I. hood yellow 2 and 3 the 4C. I. hood red 7 and 914C. I. food blacks 1 and 2

[0074] As a substantivity color. C. The I. direct yellow 11224263344 and 50120132 the 14214486C. I. direct red 14913172028313980818389 and 225227C. The I. direct oranges 26 and 29 the 62102C. I. direct blue

1261522257176798687 and 90 the 98163165199202C. I. direct blacks 192232 and 38515671747577154168171 [0075] As a basic stain. C. The I. basic yellow 12111314151921232425282932364041454951536346567707377 and 87 the 91C. I. basic red 21213141518222324272935363839464951525459686970 the

737882102104109112C. I. basic blues 135792122 and 2635414547546265666769757778899293105117120122124129137141147155C. I. basic blacks 2 and 8 [0076] As reactive dye. C. The I. reactive blacks 34711 and 12 the 17C. I. reactive yellow 151113142021222540475155 and 65 the

67C.1. reactive red 11417252632and 374446556066747996the 97C.1. reactive blues 1271415233235384163and 80and 95 grades can be used. Especially as a coloracid dye and a substantivity color are preferred and an effect excellent in improvement in the solution stability of this invention recording inka color tone and a water resisting propertyand lightfastness is acquired. As for an addition of a color as a color material in a recording ink constituent0.5 to 25 weight % is preferredand it is 2 to 15 weight % more preferably.

[0077]An inorganic pigment and an organic color can be used especially for paints used for this inventionwithout limiting the kind. since it does not dissolve in recording ink but is distributing as particles compared with a colorit becomes possible for paper to be deep to be alike to be hard to permeateeven if it is recording ink of the same osmosis characteristicand to obtain good image quality which has high image densityand few strike-throughs therefore.

[0078]As an inorganic pigmenttitanium oxide and iron oxidecalcium carbonatebarium sulfateIn addition to aluminium hydroxidebarium yellowcadmium redand chrome yellowcarbon black manufactured by publicly known methodssuch as the contacting methodthe furnace methodand thermal \*\*can be used.

[0079]moreover -- as an organic color -- an azo pigment (an azo rake and insoluble azo pigment.) Polycyclic type paints containing a disazo condensation pigmenta chelate azo pigmentetc. for examplephthalocyanine pigmentperylene pigmentand peri non -- paints and anthraquinone paints. Color chelate (for examplebasic stain type chelateacid dye type chelateetc.) and nitro paintssuch as a quinacridone pigmentdioxazine paintsindigo paintsthoindigo paintsan isoindolinone pigmentand kino FURARON paintsnitroso paintsaniline blacketc. can be used. A good thing of water and compatibility is preferably used among these paints. As for an addition of paints as a color material in a recording ink constituent0.5 to 25 weight % is preferredand it is 2 to 15 weight % more preferably.

[0080]Although paints in particular preferably used in this invention are not limitedas an object for blackCarbon black (C. 1. pigment black 7)such as furnace blacklamp blackacetylene blackand channel black. Or organic colorssuch as metalsuch as copperiron (C. 1. pigment black 11)and titanium oxideand aniline black (C. 1. pigment black 1)are raised.

[0081]As an object for colorsthe C.1. pigment yellow

131213141724343537and 42 (Synthetic

Ochre)53558183959798100101104408109110117120138150153the C.1. pigment oranges 51316173643and 51the C.1. pigment red 1235and 17223313848:248:2

(Permanent Red 2B (Ca))48:348:449:152:253:157:1 (brilliant carmine  
6B)60:163:163:264:1818388101 (red oxide)104105106108 (cadmium  
red)112114122 (Quinacridone  
magenta)123146149166168170172177178179185190193209219the C.I. pigment  
violet 1 (rhodamine lake)35:116192338the C.I. pigment blues 1215 (copper  
phthalocyanine blue)and 15:115:215:3 (copper phthalocyanine  
blue)1617:1566063the C.I. pigment greens 1478101718and 36etc. are  
mentioned.

[0082]As for the paints for blacksin this inventionit is preferred that  
it is carbon black. As black recording inkit excels in a water resisting  
property\*\*\*\*\*and a dispersion stabilityand carbon black is inexpensive  
while it is excellent in a color tone.

[0083]In additionthe surface of paints (for examplecarbon) is processed  
by resin etc.and the graft paints whose distribution was enabled  
underwaterthe processing pigment which added functional groupssuch as a  
sulfone group and a carboxyl groupto the surface of paints (for  
examplecarbon) and whose distribution was enabled underwateretc. can be  
used. A microcapsule may be made to include paints and these paints may  
be made into the what thing can be distributed underwater.

[0084]As for the aqueous recording liquid of this inventionit is  
preferred to come to distribute paints in the range whose mean particle  
diameter is 10 nm - 200 nm. Mean particle diameter here puts the value  
of 50% of volume cumulative percent. In order to measure the value of  
50% of volume cumulative percentThe particles which are performing  
Brownian motion in recording ink are irradiated with a laser beamand the  
method called dynamic light scattering (Doppler scattered-light  
analysis) which calculates particle diameter from the variation of the  
pitch (frequency of light) of the light (backscattered light) which  
returns from particles can be used. As a grading analysis meter using  
this systemthe micro track grading analysis meter LHPA150 grade by  
HoneywellInc. can be used.

[0085]If colorant is used as paintsa water resisting property and  
lightfastness will become goodand furtherrecording ink escapes from a  
layer of a recording mediumit oozes out to a rear faceand a \*\*\*\*  
phenomenon (it is only hereafter described as a strike-through.) can be  
prevented. Since it is hard to enter into a recording medium in a  
recording medium compared with a liquid component of recording ink and  
remains near the surface of a recording medium when it is printed by an  
ink jetsince paints are not dissolving and are distributed in recording  
inkthe drying property can prevent a strike-through quickly. on the  
other handsince there will be few effects of preventing a strike-

through the dispersion stability of recording ink will be bad in not less than 200 nm and particle diameter will become large by condensation etc. at the time of preservation if mean particle diameter is 10 nm or less compared with a case where mean particle diameter of paints is in a mentioned range a jetting stability may be inferior.

[0086] As for paints it is preferred to be added by recording ink as pigment dispersion liquid produced by distributing in an aqueous medium with a dispersing agent. As a desirable dispersing agent a publicly known dispersing agent used for preparing publicly known pigment dispersion liquid conventionally can be used. The following are mentioned as a polymer dispersing agent.

[0087] As hydrophilic giant molecules by a natural system gum arabic TORAGAN gum good AGAMUKaraya gum low power SUTOBINGAMU arabino galla KUTOXpectin Vegetable polymers such as quince seed starch alginic acid carrageenan Animal system polymers such as seaweed system polymers such as agar gelatin casein albumin and collagen By microorganism system polymers such as xanthene gum and dextran and a semisynthesis system methyl

cellulose Ethyl cellulose hydroxyethyl cellulose hydroxypropyl cellulose Fibrin system polymers such as carboxymethyl cellulose sodium carboxymethyl starch Starch system polymers such as sodium starch phosphate sodium alginate In seaweed system polymers such as alginic acid BUROPIREN glycol ester and a pure constructional system polyacrylic acid A polymethacrylic acid and acrylic acid-acrylonitrile copolymer A vinyl acetate acrylic ester copolymer An acrylic acid-acrylic acid-alkyl-ester copolymer A styrene acrylic acid copolymer A styrene methacrylic acid copolymer A styrene acrylic acid-acrylic acid-alkyl-ester copolymer A styrene methacrylic acid-acrylic acid-alkyl-ester copolymer A styrene alpha-methylstyrene acrylic acid copolymer A styrene alpha-methylstyrene acrylic acid copolymer-acrylic acid-alkyl-ester copolymer A styrene maleic acid copolymer A vinyl naphthalene-maleic acid copolymer A vinyl acetate ethylenic copolymer A vinyl acetate fatty acid vinyl ethylenic copolymer A vinyl acetate ester maleate copolymer A vinyl acetate crotonic acid copolymer A vinyl acetate acrylic acid copolymer etc. are raised. As for these copolymers it is preferably [ an average molecular weight is preferred and ] desirable to 3000-50000 and a pan 5000-30000 and that it is 7000-15000 especially preferably. \*\*\*\* addition of the addition of a polymer dispersing agent can be carried out in the range which distributes paints stably and does not make other effects of this invention lose.

[0088] As for the quantitative ratio of paints and a dispersing agent it is preferably desirable to the paints 1/0.06 to 3 times as many weight

ranges and that they are 0.125 to 3 times as many weight ranges to the paints I more preferably.

[0089] It is also possible to use a water soluble surfactant as a pigment agent. In this case the rise of the ink viscosity to the amount of the water soluble surfactant used is smaller than the case where a polymer dispersing agent is used and when it is used for an ink-jet-recording method the pigment ink which has the good regurgitation characteristic can be obtained easily.

[0090] As an example of the water soluble surfactant used as a pigment agent as an anionic surface active agent alkyl allyl or alkyl naphthalenesulfonate, an alkyl-phosphoric-acid salt, alkyl sulfate, an alkyl-sulfonic-acid salt, alkyl ether sulfate, alkyl sulfosuccinate, alkyl ester sulfate, alkyl benzene sulfonates, alkyl diphenyl ether disulfonate, an alkyl aryl ether phosphate, an alkyl aryl ether sulfonate, an alkyl aryl ether ester sulfate, an alkyl olefin sulfonate, an alkyl olefin sulfonate, a polyoxyethylene-alkyl-ether phosphate, the condensate of polyoxyethylene-alkyl-ether sulfuric ester salt, ether carboxylates, sulfosuccinate,  $\alpha$ -sulfo fatty acid ester, fatty acid salt, higher fatty acid, and amino acid naphthenate, etc. are mentioned.

[0091] As a cationic surface active agent, an alkylamine salt, a dialkylamine salt, a tertiary amine salt, a quaternary ammonium salt, a pyridinium salt, an imidazolium salt, a sulfonium salt, a phosphonium salt, etc. are mentioned.

[0092] As a nonion system surface-active agent, polyoxyethylene alkyl ether, polyoxyethylene alkyl aryl ether, polyoxyethylene alkyl phenyl ether, polyoxyethylene glycol ester, polyoxyethylene fatty acid amide, polyoxyethylene fatty acid ester, a polyoxyethylene polyoxypropylene glycol, the polyoxyethylene ether of glycerol ester, sorbitan ester, sucrose esters, and glycerol ester, the polyoxyethylene ether of sorbitan ester, the polyoxyethylene ether of sorbitol ester, fatty acid alkanolamide, an amine oxide, polyoxyethylene alkylamine, a glycerine fatty acid ester, a sorbitan fatty acid ester, polyoxyethylene sorbitan fatty acid ester, polyoxyethylene sorbitol fatty acid ester, alkyl (poly) glycoxyde, etc. are mentioned.

[0093] As an ampholytic surface active agent, imidazoline derivatives such as imidazolium betaine, dimethyl alkyl lauryl betaine, an alkyl glycine, alkyl di(aminoethyl) glycine, etc. are mentioned. \*\*\*\* addition of the addition of the surface-active agent as a dispersing agent can be carried out in the range which distributes paints stably and does not make other effects of this invention lose.

[0094] As for the dispersing agent in the above-mentioned recording ink, it is preferred to have a carboxyl group still more preferably. If the

dispersing agent has a carboxyl group while high-definition print quality is acquired a dispersion stability not only improves but the water resisting property of the recording medium after printing will improve more and the effect of preventing the further above-mentioned strike-through will be acquired. When an ingredient (A) and an ingredient (B) are used together with the paints distributed with the dispersing agent which has a carboxyl group especially also in the case where it prints to recording media with the comparatively high degree of size such as a regular paper sufficient drying rate is obtained and the effect that there are few strike-throughs can be acquired. Since it is small as compared with the acid radical of others [dissociation constant / of carboxylic acid] after paints adhere to a recording medium this by an interaction with polyvalent metal ions such as a fall of the pH value of recording ink and calcium which exists near the recording medium surface etc. The solubility of the dispersing agent itself falls and it is presumed that it originates in the dispersing agent itself and paints condensing.

[0095] The aqueous recording liquid by this invention has the more preferred form which the paints which surface treatment was carried out and the carboxyl group has combined are distributing underwater. In this case since surface treatment of the paints was carried out and the carboxyl group has joined together while a dispersion stability not only improves but high-definition print quality is acquired by the same operation as \*\*\*\* the water resisting property of the recording medium after printing improves more. Since the redispersibility after desiccation is excellent the recording ink of this form stops prolonged printing also when the moisture of the recording ink near the nozzle of an ink jet head evaporates it does not cause blinding but can perform good printing easily by easy cleaning operation.

[0096] Application to bar code printing by invisible recording ink and postmark printing which are spreading through urgency in recent years is also possible. In this case instead of the usual color and paints it does not have absorption in a visible region but an infrared absorption agent which has absorption in infrared rays or ultraviolet rays or an ultraviolet ray absorbent is added in recording ink.

[0097] An additive agent conventionally known besides the above-mentioned colorant a wetting agent and a surface-active agent can be added to an aqueous recording liquid of this invention in the range in which an effect of this invention is not lost. For example a resin emulsion may be added by aqueous recording liquid of this invention. A continuous phase is water and a resin emulsion which can be used for this invention means

an emulsion whose disperse phases are the following resinous principles. As a resinous principle of such a disperse phase an acrylic resin vinyl acetate resin styrene butadiene resin vinyl chloride resin acrylic styrene resin butadiene resin styrene resin etc. are raised. As for this resin it is preferred that it is a polymer having a hydrophilic portion and a hydrophobic part. Particle diameter of these resinous principles is not limited especially as long as an emulsion is formed but about 5-100 nm is more preferably desirable about 150 nm or less preferably.

[0098] These resin emulsions can obtain a resin particle by mixing in water with a surface-active agent by a case, as a commercial resin emulsion -- the micro gell E-1002 and E-5002 (a styrene acrylic resin emulsion.) the NIPPON PAINT CO. LTD. make and BONKOTO 4001 (an acrylic resin emulsion.) the Dainippon Ink and Chemicals Inc. make and BONKOTO 5454 (a styrene acrylic resin emulsion.) The Dainippon Ink and Chemicals Inc. makes SAE-1014 (a styrene acrylic resin emulsion) the ZEON CORPORATION make SAIBI Norian SK-200 (an acrylic resin emulsion) the SAIDEN CHEMICAL INDUSTRY CO. LTD. make etc. are raised. An aqueous recording liquid of this invention is 1 to 25 weight % of a range preferably [containing a resin emulsion so that the resinous principle may become 0.1 to 40 weight % of recording ink] and more preferably. A resin emulsion has the character thickened and condensed controls osmosis in a paper depth direction of a coloring component and has an effect which promotes fixing to a recording material further. Depending on a kind of resin emulsion a coat is formed on a recording material and it has the effect of also raising the scuff resistance of printed matter.

[0099] In an aqueous recording liquid of this invention a recording ink constituent may contain sugar for the purpose of controlling moisture evaporation. As an example of sugars monosaccharide disaccharide oligosaccharide (trisaccharide and tetrasaccharide are included) and polysaccharide are raised. Glucose, mannose, fructose, a ribose, xylose, arabinose, galactose, malt sugar, cellobiose, lactose, sucrose, trehalose, maltotriose etc. are raised preferably. Here polysaccharide means sugar in a broad sense and suppose that it uses for a meaning containing a substance which exists in nature such as alpha-cyclodextrin and cellulose widely. moreover -- as the derivative of these sugars -- reducing sugar (for example sugar-alcohol (expressed with general formula  $\text{HOCH}_2(\text{CHOH})_n\text{CH}_2\text{OH}$  (an integer of  $n=2-5$  is expressed here).) of said sugars carried out. Oxidation sugar amino acid (for example aldonic acid, uronic acid etc.) thio acid etc. are raised. Especially sugar-alcohol is preferred and maltitol, sorbitol etc. are raised as an example. content of these sugars --

- a recording ink constituent --- 0.5 to 30weight % of a range is preferably suitable 0.1 to 40weight %.

[0100]An aqueous recording liquid of this invention may be made to contain sodium alginate. Sodium alginate is a substance contained only in brown algaeand is a hydrophilic polymer electrolyte which mainly exists as a cell membrane or an intercellular space substance. Chemicallythey are beta-D and D-Mannuronicacid combined four times. [M]alpha-D-Guluronicacid combined four times It is a polymer of [G]. If there are effectssuch as a thickening actiona stabilization effecta dispersing functiona gelling operationand a film formation operationand it adds to ink jet recording liquidby viscosity change by plla deposit by saltsand gelling with a multivalent cation. A monochromatic blot (feathering) and a blot (color bleeding) between different colors are improvable.

[0101]In an aqueous recording liquid of this inventionsodium dehydroacetatesodium sorbate2-pyridine thiol 1-oxide sodiumsodium benzoatepentachlorophenol sodiumetc. may be added as a preservation-from-decay antifungal agent.

[0102]As a pH adjusterif an adverse effect can be adjusted to recording ink prepared at a value of a request of pH to \*\*\*\*\*arbitrary substances can be used for an aqueous recording liquid of this invention. As the exampleaminesuch as diethanolamine and triethanolamineCarbonate of alkaline metalssuch as hydroxide of alkali metalssuch as lithium hydroxidesodium hydroxideand a potassium hydrateammonium hydroxidethe 4th class ammonium hydroxidethe 4th class phosphonium hydroxidelithium carbonatesodium carbonateand potassium carbonateetc. are mentioned. As a chelating reagentthere are hydroxyethyl ethylenediamine[ sodium ethylenediaminetetraacetatesodium nitrilotriacetic acidand sodium ] triacetatediethylenetriamine pentaacetic acid sodiumreverse side mill sodium diacetateetc. for example.

[0103]In an aqueous recording liquid of this inventionacid sulfite saltsodium subsulfitetethiodiglycolic acid Amona diisopropyl ammonium nit lightpentaerythritol tetranitratea dicyclohexyl ammonium nit lightetc. may be added as rust preventivesfor example. A water-soluble ultraviolet ray absorbent can also be added according to the purpose.

[0104]Although the aqueous recording liquid of this invention makes an aqueous recording liquid breathe out as droplet from a detailed deliveryor is dispersedit divides to the ink jet recording method which forms a color picture in a recording medium and it is used suitablyIt is not necessary to say that it can be used as common writing materials and recorderssuch as an aqueosity penan aqueosity markerand aqueous ball

pens and recording ink for pen plotters. The aqueous recording liquid of this invention is not limited to the above-mentioned use.

[0105] The aqueous recording liquid of this invention needs to adjust recording ink viscosity to a desired value when using it for an ink jet recording method. As for the viscosity of an aqueous recording liquid although it is dependent on the discharging force of a head it is preferred that they are generally 10 or less mPa·s. If larger than 10 mPa·s regurgitation sufficient in an ink jet cannot be performed but the problem of an image defect will occur in many cases.

[0106] The record method of this invention gives the thermal energy corresponding to a record signal to recording ink droplet is generated with this thermal energy and the method of forming a picture in a recording medium is used suitably.

[0107] A recording medium uses a pulp fiber as the main ingredients and it is preferred that they are 10 s or more of the degrees of size and the air permeability 5-50 s. Even if it prints with an ink jet recording method to both sides of such a recording medium using the aqueous recording liquid of this invention recognition of a surface picture is not barred by the picture on the back. It is carried out by following  $\text{Stokist} \cdot \text{size} \cdot \text{degree}$  test method JISP8122-76 of paper with the degree of size here and following air permeability test method JISP8117-80 of paper and a paperboard with air permeability.

[0108] If the degree of size is smaller than 10 s recording ink permeates to a rear face a strike-through occurs also when air permeability is smaller than 5 s recording ink will permeate to a rear face and a strike-through will occur. When the degree of size is 50 s or more it is satisfactory to print quality or drying property but since the amount of \*\* is added more than needed cost will become high. When the degree of size and air permeability use a recording medium which is outside a mentioned range for a copying machine and a printer of an electrophotographing system the amount of \*\* is transferred by a photoconductor fixing roller etc. and it becomes deterioration of imaging quality and a cause of failure. Therefore it is necessary to use paper only for an ink jet after all consumers must be made to use properly and it becomes a burden. If the degree of size and air permeability use a recording medium in a mentioned range a transfer paper for electrophotography can treat like a regular paper of various non coat such as a print sheet a typewriter paper a stylus printer paper a word processor paper a letter paper and writing paper and time and effort which a user classifies with other regular papers in connection with it is lost. A production top can also be fundamentally produced with a paper

machine of current possession and plant-and-equipment investment can be pressed down to the minimum. It can be used common also to a use of a recording mode besides these.

[0109] As a material of a pulp fiber used for this invention if influence is a thing which is not it can be suitably used for an ink jet process regardless of a kind of pulp and a disposal method. Non-wood pulp (a kenafflaxa bambooseaweed etc.) and recycled pulp can also be used and it is good also considering this as a subject. Chemical pulp preferably represented by LBKP and NBKP can be raised. Like a general regular paper a publicly known sizing compound and a loading material and other paper-making auxiliary agents are used for paper making of these pulp if needed and paper making is carried out by a conventional method. As a sizing compound there are rosin size AKD sodium chloride potassium chloride styrene maleic acid copolymer quaternary ammonium salt an ARUNIKERU succinic anhydride petroleum resin system size EPIKURORUHIDON cation starch acrylamide etc. As a loading material calcium carbonate talc titanium dioxide synthetic silica etc. are mentioned. Furthermore a paper reinforcing agent a yield improver a fixing agent a colorant and other paper-making auxiliary agents are added.

[0110] In a case where recording ink of this invention is used for an ink-jet recording device as a result of these people's repeating examination wholeheartedly when the discharge quantity  $V$  (pl) per [ which is breathed out from a recording head ] drop records by [ as satisfying a relation shown by the following formula (3) ] in printing what is called to a regular paper there were few strike-throughs and a poor picture was easy to be buried and it found out that a good picture without a white omission was acquired.

$2.5 \times 10^6 / R^{2.6} < V < 6.0 \times 10^6 / R^{2.6}$  .... (3) Here RA pulp fiber is used as the main ingredient density into which droplet when recording to a recording medium which are more than size degree 10S and the air permeability 5-50S is driven is expressed as the number of placing to unit length and a unit uses dpi (= Dot Per Inch). In the case of an ink jet printer of a serial type placing densities in a scanning direction (scanning direction) and a paper transportation direction (vertical scanning direction) of a head may differ but. In this case it is preferred to use a value which converted the number of placing per unit area so that it might become equal in a scanning direction and a vertical scanning direction.

[0111] A formula (3) does not generate a white muscle etc. when left-hand side of a formula (3) usually forms a poor picture in the paper but it shows a relation suitable for obtaining high image density and right-hand

side of a formula shows a relation suitable for preventing increase of strike-through concentration generating of a blot etc. by making superfluous recording ink adhere. It is a relation materialized only after any relation has the outstanding osmosis characteristic to a regular paper of recording ink of this invention.

[0112] When recording ink of this invention is used perviousness is high and since a quality picture without a blot is acquired application in a difficult speed recording process is possible usual. Namely so that at least a part of picture element region may lap on a recording medium speed recording becomes possible dramatically by a discharge time difference of two recording ink droplets which produce a lap for two or more recording ink droplets on a recording medium in regurgitation and a record method which makes it disperse and forms a picture in a recording medium being 0.125 millisecond or less from a same or separate delivery. A dot in adjoining physical relationship is not formed continuously and it was not making another ink reach the target in order to maintain a certain amount of high definition although technology about an ink jet printer accomplishes remarkable progress and printing speed's is improving in recent years until one side sank into Kaminaka. That is it can be said that high-definition printing is attained by a method called what is called multipass printing sacrificing printing speed. Since recording ink of this invention showed the very high osmosis characteristic in the former high-definition printing of it by a single pass which could not be accomplished was attained.

[0113] Although the ink-jet recording device possessing the recording fluid cartridge and recording fluid cartridge which accommodated the aqueous recording liquid of this invention is explained with reference to an accompanying drawing the following is only one of the examples of composition and this invention is not limited at all. Drawing 1 is an outline front view of the mechanism part of the serial type ink-jet recording device which carries the ink cartridge provided with the recording ink seat part which accommodated the recording ink of this invention.

[0114] the mechanism part of this ink-jet recording device -- between the side boards 1 and 2 of both sides -- the main support guide rod 3 and the auxiliary support guide rod 4 -- abbreviated -- it constructs across horizontally by level physical relationship and the carriage unit 5 is slidably supported to the scanning direction with these main support guide rods 3 and auxiliary support guide rods 4. In the carriage unit 5 respectively Yellow (Y) ink magenta (M) ink The four heads 6 which carry out the regurgitation of cyanogen (C) ink and the black (Bk)

ink respectively. The regurgitation side (nozzle face) 6a is turned caudad and is carried and the four ink cartridges 7y7m7c and 7k which are the ink supply bodies of each color for supplying ink to the four heads 6 respectively are carried in the head 6 upper part of the carriage unit 5 exchangeable. And the carriage unit 5 is connected with the timing belt 11 which is interposed between the driving pulley (drive timing pulley) 9 and the driven pulley (idler belt pulley) 10 which rotate by the horizontal-scanning motor 8. He is trying to move the carriage 5 in the four heads to a scanning direction by carrying out drive controlling of the horizontal-scanning motor 8.

[0115] The subframes 13 and 14 are set up on the bottom plate 12 which connects the side boards 1 and 2 and the transportation roller 15 for sending to a vertical scanning direction which intersects the paper 16 perpendicularly with a scanning direction between this subframe 13 and 14 is held enabling free rotation. And in order to allocate the vertical-scanning motor 17 in the subframe 14 side and to transmit rotation of this vertical-scanning motor 17 to the transportation roller 15 it has the gear 18 fixed to the axis of rotation of the vertical-scanning motor 17 and the gear 19 fixed to an axis of the transportation roller 15. Between the side board 1 and the subframe 12 the reliability maintenance recovery mechanism (henceforth a "subsystem") 21 of the head 6 is arranged. The subsystem 21 holds the four capping means 22 which cap a regurgitation side of each head 6 with the holder 23 and holds this holder 23 rockable by the link member 24. Because the carriage unit 5 contacts the engagement part 25 provided in the holder 23 by movement of a scanning direction of the carriage unit 5. Because the holder 23 carries out a lift rise according to movement of the carriage unit 5 on the regurgitation side 6a of the ink jet head 6 by the capping means 22 and the carriage unit 5 moves to the printing area side. According to movement of the carriage unit 5 the holder 23 carries out a lift downward he is trying for the capping means 22 to separate from the regurgitation side 6a of the ink jet head 6.

[0116] It connects with the suction pump 27 via the suction tube 26 respectively and the capping means 22 forms an atmosphere release mouth and is open for free passage to the atmosphere via an atmosphere release tube and an atmosphere release valve. The suction pump 27 is discharged to a waste fluid depot which does not illustrate attracted waste fluid via a drain tube etc. A fiber component which carries out wiping of the regurgitation side 6a of the ink jet head 6 to the side of the holder 23. He attaches to the blade arm 29 the wiper blade 28 which is a wiping means which consists of elastic members such as a foamed member.

or rubber and is trying to make this blade arm 29 rock by rotation of a cam which is supported pivotally rockable and rotated by a driving means which is not illustrated.

[0117] Next the ink cartridge 7 is explained with reference to drawing 2 and drawing 3. Here an appearance perspective view of an ink cartridge before loading recording equipment with drawing 2 and drawing 3 are the right sectional views of an ink cartridge.

[0118] The ink cartridge 7 accommodates the ink absorber 42 which made ink of a necessary color absorb in the cartridge body 41 as shown in drawing 3. It pastes up or \*\*\*\*s and the cartridge body 41 forms the top-cover component 44 in the upper part at an upper opening of the case 43 where it has a large opening for example consists of a resin mold article. The ink absorber 42 consists of porous bodies such as a urethane foam object and after compressing and inserting into the cartridge body 41 it is making ink absorb. The ink feed opening 45 for supplying ink to the recording head 6 is formed in case 43 pars basilaris ossis occipitalis of the cartridge body 41 and the seal ring 46 is attached in this ink feed opening 45 inner skin. The atmosphere release mouth 47 is formed in the top-cover component 44. To the cartridge body 41 in the state before charge both as if the ink feed opening 45 is taken up at and the time of cartridge handling at the time of charge and transportation etc. Or in order to prevent internal ink from the compression set of the case 43 being carried out by a pressure concerning a broad side attachment wall by the time of a vacuum package and being revealed it has equipped with the cap member 50.

[0119] As shown in drawing 2 oxygen permeability sticks the film state seal member 55 more than  $100 \text{ ml/m}^2$  on the top-cover component 44 and is carrying out the seal of the atmosphere release mouth 47. This seal member 55 also makes two or more slots 48 formed in that circumference with the atmosphere release mouth 47 a size which carries out a seal. By thus a thing which oxygen permeability does for the seal of the atmosphere release mouth 47 by the seal member 55 more than  $100 \text{ ml/m}^2$ . By packing the ink cartridge 7 by a reduced pressure state using packaging members such as an aluminum laminate film without infiltration. Even when a gas is dissolved in ink for the atmosphere in the space A (refer to drawing 3) produced between the time of ink restoration the ink absorber 42 and the cartridge body 41 air in ink is discharged via the seal member 55 by space between packaging members besides the cartridge body 41 with a high degree of vacuum and a deaeration degree of ink improves.

[0120] An example of composition of a record cartridge provided with a

recording ink seat part which accommodated recording ink of this invention and a head section for making a recording ink drop breathe out is shown and explained to drawing 4. That is the recording unit 30 is a thing of a serial type and the principal part comprises the ink jet head 6, the ink tank 41 which accommodates recording ink supplied to this ink jet head 6 and a lid member which seals inside of this ink tank 41. Many nozzles 32 for carrying out the regurgitation of the recording ink are formed in the ink jet head 6. Recording ink is led to a common fluid chamber which is not too illustrated via an ink supply pipe which is not illustrated from the ink tank 41 and is breathed out from the nozzle 32 according to an electrical signal from a recording device body inputted from the electrode 31. A such type recording unit is a structure suitable for a head made into the source of power of a drive of thermal energy called a head of a type which can be manufactured inexpensive constitutionally what is called a thermal system and a bubble system. In record methods such as a bubble and a thermal system since a wettability to a thermal element is improved by adding an ingredient (A) a jetting stability and frequency stability are acquired also with a little additions and safety of recording ink of this invention is also high and it is dramatically suitable.

[0121] Here although the above serial type ink-jet recording devices were explained the recording ink of this invention can also be applied to the recording equipment which is the same as the resolution of the picture made into the purpose or piled up 1/several about density and made the nozzle arrange in arbitrary arrangements such as zigzag more than the width of a recording medium and which has what is called a line head. Recording equipment here may be equipment which has the complex function combined with not only the output printer for PC or digital cameras but faxa scanner a telephone etc.

[0122] (EXAMPLE) Although the embodiment and comparative example of this invention are shown below this invention is not limited to these. The quantity (%) of each ingredient given in an embodiment is a weight reference.

[0123] (Embodiment 1) After carrying out mixed stirring by the following ink formula 10% of lithium hydroxide solution adjusted so that pH might be set to eight. Then it filtered with the membrane filter of 0.1 micrometer of average pore sizes and the ink composition 1 was obtained.  
Ink composition 1 C.I. direct black 168 4 weight % glycerin 5 weight % ethylene glycol 5 weight % compound (1-4) They are 2,2,4-trimethyl and 3-pentanediol 1 weight % ion exchange water 0.3 weight %.  
Residue [0124] (Embodiment 2) Except using the following constituent like

Embodiment 11 adjusted in sodium hydroxide and was considered as the ink composition 2 so that pH might be set to 7.5.

Ink composition 2C.1. direct yellow 142 3.0 weight % thiodiglycol 8 weight % compound (1-5) They are 224-trimethyl 1 and 3-pentanediol 3 weight % ion exchange water 0.5weight %. Residue[0125](Embodiment 3) Except using the following constituentlike Embodiment 110% of lithium hydroxide solution adjustedand it was considered as the ink composition 3 so that pH might be set to eight.

Ink composition 3C.1. Dailekh tread 227 3 weight % thiodiglycol 8 weight % compound (1-6) They are 224-trimethyl 1 and 3-pentanediol 2 weight % ion exchange water 0.5weight %. Residue[0126](Embodiment 4) Except using the following constituentlike Embodiment 110% of lithium hydroxide solution adjustedand it was considered as the ink composition 4 so that pH might be set to nine.

Ink composition 4C.1. direct blue 199 A 3 weight % thiodiglycol 8 weight % compound (1-5) They are 224-trimethyl 1 and 3-pentanediol 3 weight % ion exchange water 0.5weight %. A residue[0127](Embodiment 5) Carbon black was first distributed using a bead mill by the following dispersion-liquid formula. After carrying out mixed stirring of the obtained aqueous dispersion liquid by the following ink formula10% of lithium hydroxide solution adjusted so that pH might be set to eight. Then it filtered with a membrane filter of 0.8 micrometer of average pore sizesand the ink composition 5 was obtained.

Pigment dispersion liquid 1 carbon black (mean particle diameter of 104 nm). 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 5 pigment-dispersion liquid 1 A 6.5 weight % of 33.3 weight % diethylene-glycols glycerin 3.5 weight % compound (1-1). 25% solution of 0.1 weight % of 0.3 weight % compound (1-3) compound (13-3) 0.5 weight % 224-trimethyl 13-pentanediol 2 weight % 2-pyrrolidone 2 weight % ion exchange water A residue[0128](Embodiment 6) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 2 was produced and the ink composition 6 was obtained using it.

Pigment dispersion liquid 2 carbon black (mean particle diameter of 104 nm). 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 6 pigment-dispersion liquid 2 33.3 weight % ethylene glycol 6.5 weight % N-methyl-2-pyrrolidone . 3.5 weight % compound (1-1) 25% solution [ ] of the 0.3 weight % compound (13-4) -- 0.5 weight % -- 224-trimethyl 13-pentanediol 3 weight % 2-pyrrolidone 2 weight % Fluorination alkyl ester; -- nonionic surface active agent 0.3 weight % ion exchange water

Residue[0129] (Embodiment 7) Except using the following constituent the pigment dispersion liquid 3 was produced like Embodiment 5 and the ink composition 7 was obtained using it.

Pigment dispersion liquid 3 carbon black (mean particle diameter of 99 nm). Formalin condensate [ of a 15 weight % naphthalene sulfonate ] . 3 weight % ion exchange water The residue ink composition 7 pigment-dispersion liquid 3. The 33.3 weight % polyethylene glycol (molecular weight 200). the 15 weight % compound (1-3) the 25% solution [ ] of the 0.05 weight % compound (13-2) -- 0.1 weight % -- 224-trimethyl 1 and 3-pentanediol 5 weight % fluorination alkyl ester; nonionic surface active agent 0.3 weight % ion exchange water A residue[0130] (Embodiment 8) Except using the following constituent like Embodiment 5 the pigment dispersion liquid 4 was produced and the ink composition 8 was obtained using it.

3 weight % of pigment dispersion copolymer [ liquid 4C.1. pigment yellow 13 (mean particle diameter of 117 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt ] ion exchange water Residue ink composition 8 pigment-dispersion liquid 4 33.3 weight % glycerin . A 5 weight % diethylene-glycol 10 weight % compound (1-2) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 3 weight % 2-pyrrolidone 2 weight % ion exchange water A residue[0131] (Embodiment 9) Except using the following constituent like Embodiment 5 the pigment dispersion liquid 5 was produced and the ink composition 9 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment dispersion liquid 5C.1. pigment yellow 74 (mean particle diameter of 96 nm) 15 weight % naphthalene sulfonate Residue ink composition 9 pigment-dispersion liquid 5 The 33.3 weight % polyethylene glycol (molecular weight 200). 10 weight % compound (1-7) They are 224-trimethyl 1 and 3-pentanediol 5 weight % ion exchange water 0.05 weight %. Residue[0132] (Embodiment 10) Except using the following constituent like Embodiment 5 the pigment dispersion liquid 6 was produced and the ink composition 10 was obtained using it.

Pigment dispersion liquid 6C.1. pigment red 122 (mean particle diameter of 120 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 10 pigment-dispersion liquid 6 33.3 weight % glycerin . 5 weight % ethylene glycol 10 weight % compound (1-1) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 2 weight % 2-pyrrolidone 2 weight % ion exchange water Residue[0133] (Embodiment 11) Except using the following constituent like Embodiment 5 the pigment

dispersion liquid 7 was produced and the ink composition 11 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment dispersion liquid 7C.1. pigment red 57:1 (mean particle diameter of 115 nm) 15 weight % naphthalene sulfonate Residue ink composition 11 pigment-dispersion liquid 7 The 33.3 weight % polyethylene glycol (molecular weight 200). 10 weight % compound (1-8) 0.05 weight % 2-methyl-13-hexandiol 1 weight % 224-trimethyl 13-pentanediol 1 weight % 2-pyrrolidone 2 weight % ion exchange water Residue[0134] (Embodiment 12) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 8 was produced and the ink composition 12 was obtained using it.

A pigment dispersion liquid 8C.1. pigment blue 15:3 (mean particle diameter of 123 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 12 pigment-dispersion liquid 8 33.3 weight % glycerin . A 3 weight % 15-pentanediol 15 weight % compound (1-4) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 5 weight % 2-pyrrolidone 2 weight % ion exchange water A residue[0135] (Embodiment 13) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 9 was produced and the ink composition 13 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment dispersion liquid 9C.1. pigment blue 56 (mean particle diameter of 138 nm) 15 weight % naphthalene sulfonate Residue ink composition 13 pigment-dispersion liquid 9 The 33.3 weight % polyethylene glycol (molecular weight 200). The 10 weight % compound (1-9) 0.05 weight % 224-trimethyl 13-pentanediol 4 weight % triethylene glycol monobutyl ether 2 weight % ion exchange water A residue[0136] (Embodiment 14) The ink composition 14 was obtained like Embodiment 1 except using the following constituent. Ink composition 14 carboxyl-group knot-pattern carbon black dispersion liquid 33.3 weight % (16.4 weight % of solid content mean particle diameter of 128 nm)

Diethylene-glycol 15 weight % glycerin 5 weight % compound (1-4) 0.8 weight % 224-trimethyl 13-pentanediol 2 weight % N-methyl-2-pyrrolidone 2 weight % ion exchange water Residue[0137] (Embodiment 15) The ink composition 15 was obtained like Embodiment 1 except using the following constituent.

Ink composition 15 carboxyl-group knot-pattern carbon black dispersion liquid 33.3 weight % (16.4 weight % of solid content mean particle diameter of 128 nm)

Ethylene glycol 15 weight % compound (1-1) 1 weight % 224-trimethyl 13-pentanediol 3 weight % N-methyl-2-pyrrolidone 2 weight % ion exchange water Residue[0138] (Embodiment 16) The ink composition 16 was obtained like Embodiment 1 except using the following constituent. Ink composition 16 sulfonic-group knot-pattern carbon black dispersion liquid 33 weight % (18 weight % of solid content mean particle diameter of 132 nm)

A 15-pentanediol 5 weight % N-methyl-2-pyrrolidone 2 weight % compound (1-6) They are 224-trimethyl 1 and 3-pentanediol 1 weight % ion exchange water 1 weight %. A residue[0139] (Embodiment 17) The ink composition 17 was obtained like Embodiment 1 except using the following constituent. Ink composition 17 sulfonic-group knot-pattern carbon black dispersion liquid 33 weight % (18 weight % of solid content mean particle diameter of 132 nm)

A 15-pentanediol 5 weight % N-methyl-2-pyrrolidone 2 weight % compound (1-1) They are 224-trimethyl 1 and 3-pentanediol 1.5 weight % ion exchange water 1 weight %. A residue[0140] (Embodiment 18) Except using the following constituent like Embodiment 5 the pigment dispersion liquid 10 was produced and the ink composition 18 was obtained using it. Pigment dispersion liquid 10 carbon black (mean particle diameter of 53 nm), 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 18 pigment-dispersion liquid 10 5 weight % of 33.3 weight % polyethylene-glycols (molecular weight 200) ethylene glycol . 30 weight % compound (1-5) They are 224-trimethyl 1 and 3-pentanediol 8 weight % ion exchange water 0.01 weight %. Residue[0141] (Embodiment 19) Except using the following constituent like Embodiment 5 the pigment dispersion liquid 11 was produced and the ink composition 19 was obtained using it.

Pigment dispersion liquid 11 carbon black (mean particle diameter of 196 nm), 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water 1133.3 weight % of residue ink composition 19 pigment-dispersion liquid 15-pentanediol 5 weight % N-methyl-2-pyrrolidone . 6.5 weight % compound (1-3) They are 224-trimethyl 1 and 3-pentanediol 5 weight % ion exchange water 4 weight %. Residue[0142] (Embodiment 20) Except using the following constituent like Embodiment 11 it adjusted in sodium hydroxide and was considered as the ink composition 20 so that pH might be set to eight.

Ink composition 20C. I. direct black 168 4 weight % glycerin 5 weight % ethylene glycol 5 weight % compound (2-4) They are 224-trimethyl 1 and 3-pentanediol 1 weight % ion exchange water 0.3 weight %. Residue[0143] (Embodiment 21) Except using the following constituent like

Embodiment 11 adjusted in sodium hydroxide and was considered as the ink composition 21 so that pH might be set to 7.5.

Ink composition 21C.1. direct yellow 142 3.0 weight % thiodiglycol 8 weight % compound (2-1) They are 224-trimethyl land 3-pentanediol 3 weight % ion exchange water 0.5weight %. Residue[0144](Embodiment 22) Except using the following constituentlike Embodiment 110% of lithium hydroxide solution adjustedand it was considered as the ink composition 22 so that pH might be set to eight.

Ink composition 22C.1. Dailekh tread 227 3 weight % thiodiglycol 8 weight % compound (2-5) They are 224-trimethyl land 3-pentanediol 2 weight % ion exchange water 0.5weight %. Residue[0145](Embodiment 23) Except using the following constituentlike Embodiment 110% of lithium hydroxide solution adjustedand it was considered as the ink composition 23 so that pH might be set to nine.

Ink composition 23C.1. direct blue 199 3 weight % thiodiglycol 8 weight % compound (2-3) They are 224-trimethyl land 3-pentanediol 3 weight % ion exchange water 0.5weight %. Residue[0146](Embodiment 24) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 12 was produced and the following ink composition 24 was obtained using it.

Pigment dispersion liquid 12 carbon black (mean particle diameter of 104 nm), 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 24 pigment-dispersion liquid 12 A 33.3 weight % diethylene-glycol 6.5 weight % glycerin 3.5 weight % compound (2-1), 0.3 weight % compound (2-4) 0.5 weight % of 25% solution 224-trimethyl 13-pentanediol 2 weight % 2-pyrrolidone 2 weight % ion exchange water of the 0.1 weight % compound (13-3) Residue[0147](Embodiment 25) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 13 was produced and the following ink composition 25 was obtained using it.

Pigment dispersion liquid 13 carbon black (mean particle diameter of 104 nm), 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 25 pigment-dispersion liquid 13 33.3 weight % ethylene glycol 6.5 weight % N-methyl-2-pyrrolidone . 3.5 weight % compound (2-3) 25% solution [ ] of the 0.3 weight % compound (13-4) -- 0.5 weight % -- 224-trimethyl 13-pentanediol 3 weight % 2-pyrrolidone 2 weight % fluorination alkyl ester; -- nonionic surface active agent 0.3 weight % ion exchange water Residue[0148](Embodiment 26) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 14 was produced and the following ink composition 26 was obtained using it.

Pigment dispersion liquid 14 carbon black (mean particle diameter of 99 nm). Formalin condensate [ of a 15 weight % naphthalene sulfonate ] . 3 weight % ion exchange water The residue ink composition 26 pigment-dispersion liquid 14. The 33.3 weight % polyethylene glycol (molecular weight 200). The 15 weight % compound (2-1) 224-trimethyl 15 weight % of 25% solution pentanediol [ 0.1 weight % / 3-] fluorination alkyl ester of the 0.05 weight % compound (13-2); nonionic surface active agent 0.3 weight % ion exchange water A residue[0149](Embodiment 27) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 15 was produced and the following ink composition 27 was obtained using it.

A pigment dispersion liquid 15. L. pigment yellow 13 (mean particle diameter of 117 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water The residue ink composition 27 pigment-dispersion liquid 15. A 33.3 weight % glycerin 5 weight % diethylene-glycol 10 weight % compound (2-5) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 3 weight % 2-pyrrolidone 2 weight % ion exchange water A residue[0150](Embodiment 28) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 16 was produced and the following ink composition 28 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment dispersion liquid 16. L. pigment yellow 74 (mean particle diameter of 96 nm) 15 weight % naphthalene sulfonate Residue ink composition 28 pigment-dispersion liquid 16 The 33.3 weight % polyethylene glycol (molecular weight 200). 10 weight % compound (2-4) They are 224-trimethyl 1and 3-pentanediol 5 weight % ion exchange water 0.05weight %. Residue[0151](Embodiment 29) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 17 was produced and the following ink composition 29 was obtained using it.

Pigment dispersion liquid 17. L. pigment red 122 (mean particle diameter of 120 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water The residue ink composition 29 pigment-dispersion liquid 17. 33.3 weight % glycerin 5 weight % ethylene glycol 10 weight % compound (2-2) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 2 weight % 2-pyrrolidone 2 weight % ion-exchange-water residue[0152](Embodiment 30) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 18 was produced and the following ink composition 30 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment

dispersion liquid 18C. I. pigment red 57:1 (mean particle diameter of 115 nm) 15 weight % naphthalene sulfonate Residue ink composition 30 pigment-dispersion liquid 18 The 33.3 weight % polyethylene glycol (molecular weight 200). 10 weight % compound (2-5) 0.05 weight % 224-trimethyl 13-pentanediol 1 weight % 2-pyrrolidone 2 weight % ion exchange water Residue[0153] (Embodiment 31) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 19 was produced and the following ink composition 31 was obtained using it.

Pigment dispersion liquid 19C. I. pigment blue 15:3 (mean particle diameter of 123 nm) 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water The residue ink composition 31 pigment-dispersion liquid 19. 33.3 weight % glycerin 3 weight % 15-pentanediol 15 weight % compound (2-5) 25% solution of the 0.3 weight % compound (13-4) 0.5 weight % 224-trimethyl 13-pentanediol 5 weight % 2-pyrrolidone 2 weight % ion exchange water

Residue[0154] (Embodiment 32) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 20 was produced and the following ink composition 32 was obtained using it.

Formalin condensate 3 weight % ion exchange water of a pigment dispersion liquid 20C. I. pigment blue 56 (mean particle diameter of 138 nm) 15 weight % naphthalene sulfonate Residue ink composition 32 pigment-dispersion liquid 20 The 33.3 weight % polyethylene glycol (molecular weight 200). The 10 weight % compound (2-4) 0.05 weight % 224-trimethyl 13-pentanediol 4 weight % triethylene glycol monobutyl ether 2 weight % ion exchange water A residue[0155] (Embodiment 33) The following ink composition 33 was obtained like Embodiment 1 except using the following constituent.

Ink composition 33 carboxyl-group knot-pattern carbon black dispersion liquid 33.3 weight % (16.4 weight % of solid content mean particle diameter of 128 nm)

A diethylene-glycol 15 weight % glycerin 5 weight % compound (2-7) 0.8 weight % 224-trimethyl 13-pentanediol 2 weight % N-methyl-2-pyrrolidone 2 weight % ion exchange water A residue[0156] (Embodiment 34) The following ink composition 34 was obtained like Embodiment 1 except using the following constituent.

Ink composition 34 carboxyl-group knot-pattern carbon black dispersion liquid 33.3 weight % (16.4 weight % of solid content mean particle diameter of 128 nm)

An ethylene glycol 15 weight % compound (2-1) 1 weight % 224-trimethyl 13-pentanediol 3 weight % N-methyl-2-pyrrolidone 2 weight % ion exchange water A residue[0157] (Embodiment 35) The following ink composition 35

was obtained like Embodiment 1 except using the following constituent.  
Ink composition 35 sulfonic-group knot-pattern carbon black dispersion liquid 33 weight % (18 weight % of solid content mean particle diameter of 132 nm)

A 15-pentanediol 5 weight % N-methyl-2-pyrrolidone 2 weight % compound (2-3) They are 224-trimethyl land 3-pentanediol 1 weight % ion exchange water 1weight %. A residue[0158](Embodiment 36) The following ink composition 36 was obtained like Embodiment 1 except using the following constituent.

Ink composition 36 sulfonic-group knot-pattern carbon black dispersion liquid 33 weight % (18 weight % of solid content mean particle diameter of 132 nm)

A 15-pentanediol 5 weight % N-methyl-2-pyrrolidone 2 weight % compound (2-2) They are 224-trimethyl land 3-pentanediol 1.5 weight % ion exchange water 1weight %. A residue[0159](Embodiment 37) Except using the following constituentlike Embodiment 5the pigment dispersion liquid 21 was produced and the following ink composition 37 was obtained using it.

Pigment dispersion liquid 21 carbon black (mean particle diameter of 53 nm), 15 weight % styrene acrylate methacrylic acid diethanolamine salt copolymer 3 weight % ion exchange water Residue ink composition 37 pigment-dispersion liquid 21 5 weight % of 33.3 weight % polyethylene-glycols (molecular weight 200) ethylene glycol . The 30 weight % compound (2-5) They are 224-trimethyl land 3-pentanediol 8 weight % ion exchange water 0.01weight %. A residue[0160](Comparative example 1) The ink composition 38 was produced like Embodiment 5 instead of 224-trimethyl land 3-pentanediol except containing tales doses of ion exchange water.

[0161](Comparative example 2) The ink composition 39 was produced like Embodiment 25 instead of 224-trimethyl land 3-pentanediol except containing tales doses of ion exchange water.

[0162](Comparative example 3) Instead of 224-trimethyl land 3-pentanediolit added further so that a compound (1-1) might be 2 weight %and the ink composition 40 was produced like Embodiment 5 except having used the remainder as ion exchange water.

[0163](Comparative example 4) Instead of 224-trimethyl 13-pentanediol,the ink composition 41 was produced like Embodiment 6 except containing tales doses of diethylene-glycol monobutyl ether.

[0164](Comparative example 5) Instead of 224-trimethyl 13-pentanediol,the ink composition 42 was produced like Embodiment 10 except containing tales doses of diethylene-glycol monobutyl ether.

[0165] (Comparative example 6) Instead of 224-trimethyl 13-pentanediol the ink composition 43 was produced like Embodiment 24 except containing tales doses of 2-ethyl-2-methyl-13-propanediol.

[0166] (Comparative example 7) Instead of 224-trimethyl 13-pentanediol the ink composition 44 was produced like Embodiment 12 except containing tales doses of 22-diethyl-13-propanediol.

[0167] (Comparative example 8) The ink composition 45 was produced like Embodiment 33 except containing tales doses of 1 to those total amounts and 7-heptane diol instead of 224-trimethyl 13-pentamediol and a compound (2-5).

[0168] (Comparative example 9) The ink composition 46 was produced like Embodiment 6 instead of 224-trimethyl land 3-pentanediol except containing tales doses of land 8-octanediol.

[0169] (Comparative example 10) The ink composition 47 was produced like Embodiment 14 instead of 224-trimethyl land 3-pentanediol except containing tales doses of 246-trimethyl land 7-heptane diol.

[0170] (Comparative example 11) Instead of the compound (1-5) the ink composition 48 was produced like Embodiment 4 except containing the following compound (15) 6 weight %.

[0171]

[Chemical formula 9]

[0172] (Comparative example 12) After carrying out mixed stirring by the following ink formula 10% of lithium hydroxide solution adjusted so that pH might be set to eight. Then it filtered with the membrane filter of 0.1 micrometer of average pore sizes and the ink composition was obtained. Ink composition 49 C. I. acid blue 234 2 weight % polyethylene-glycol #200 6 weight % of the 10 weight % following compounds (16) are 224-trimethyl land 3-pentanediol 1 weight % ion exchange water. Residue [0173]

[Chemical formula 10]

[0174] (Comparative example 13) The ink composition 50 was produced like Embodiment 5 except containing tales doses of ion exchange water to these total amounts instead of the 25% solution of a compound (1-1) a compound (1-3) and a compound (13-3).

[0175] (Comparative example 14) The ink composition 51 was produced like Embodiment 5 except containing further tales doses of 2 to those total amounts 24-trimethyl land 3-pentanediol instead of the 25% solution of a compound (1-1) a compound (1-3) and a compound (13-3).

[0176] (Comparative example 15) Instead of the compound (1-1) the ink composition 52 was produced like Embodiment 15 except containing further tales doses of 2 to them 2,4-trimethyl and 3-pentadiol.

[0177] <Recording equipment> The examination of the ink \*\*\*\*\* following given in the above-mentioned embodiment and a comparative example was done on the next. The used recording equipment is the three following sets.

Recording equipment (A) Have two or more nozzles and it breathes out by discharge quantity 23pl per drop from each nozzle. The placing density of the droplet what is called to a regular paper has a nozzle of the maximum recording equipment [ ink jet printer ] (B) plurality of the piezo system which is 600dpi in the dense state. Breathe out by discharge quantity 4pl per drop from each nozzle and the placing density of the droplet what is called to a regular paper the maximum -- 48 nozzles of the ink jet printer recording equipment (C) 360dpi pitch of the thermal system which is 1200dpi in the dense state [ have and ] the placing density of droplet [ what is called as opposed to / it is possible to control the discharge quantity per drop to an outputted image at 1/4 in all pl(s) 7pl or pland / a regular paper ] -- the maximum -- in the dense state. The evaluation result to the recording equipment used for the ink jet printer output of the piezo system which is 720dpi and each following item is described in Table 1 and Table 2.

[0178] It was considered as the clear nature recording medium of <evaluation-criteria> 1 picture and printed on: my paper by NBS Ricoh Co. Ltd. (12 s of the degrees of size 16 s of air permeability) and a blot of a picture a color tone and concentration were synthetically judged after desiccation with viewing and a reflection type color spectrum colorimetry densimeter (made by X-Rite).

2) Time until it pushes a filter paper against the drying recording medium of a picture by the pressure of 0.1 kg/cm<sup>2</sup> at the picture after solid image printing and ink stops transferring in a filter paper was measured. When any paper was dried within in 3 seconds 0 and 3 to 20 seconds were judged to be \*\* and 20 seconds or more were judged to be x.

3) The solid picture was formed so that the concentration in each ink color measured to the strike-through recording medium with the reflection type color spectrum colorimetry densimeter (made by X-Rite) might be set to 1.0. Carried out visual observation from the rear face colorant of the solid picture has escaped from this picture to the rear face and in the case of the level which cannot be used for double-sided printing colorant of x and a solid picture has not fallen out up to the rear face but the boundary of a solid picture and blank space is

slightly indefiniteIn the case of the level which is convenient even if the boundary of \*\*a solid pictureand blank space almost uses it for double-sided printing indefinitely in the case of the level which is convenient even if it uses it for double-sided printingeven if the boundary of 0a solid pictureand blank space was completely indefinite and used it for double-sided printingwhen convenientit judged as 0.

4) When the picture formed in the scratch nature recording medium in each ink was scraped with a fingerclotha rubberand a marking pen 30 seconds after printingthe situation after a scratch was observed visuallychange of the picture by scratch occurredit was considered as x and there was no generatingit was considered as 0.

5) The picture was buriedand when it was the uneven coloring whose natural complexion can be seen by 0 and viewing when the recording medium is coloring uniformly in inkas long as it observes by 0 and viewingwhen the recording medium is coloring uniformly in inkeen if it observesexpands and observes an after-desiccation solid pictureit was considered as x.

6) Setting preservability ink to an ink jet printerit was neglected for 60 \*\* and seven daysand if it did not return \*\* and at least 5 times when the return by one cleaning operation of a publicly known ink jet printer was after that conventionally possible and the return was possible at 0 and 2 to 5 timesit was considered as x.

[0179]Printing evaluation was carried out to the following recording medium using each ink given in <recording-medium> embodiment 38 - embodiment 57 Embodiment 14.

(Embodiment 38)

Xerox Corp. make; Xerox paper R (8 s of the degrees of size20 s of air permeability)

(Embodiment 39)

The product made by AUSTRALIANPAPER (Austres11s); REFLEX (25 s of the degrees of size4 s of air permeability)

(Embodiment 40)

NBS Ricoh Co.Ltd. make; the NBS facsimile-posting paper 90K (60 s of the degrees of size68 s of air permeability)

(Embodiment 41)

Canon company make ;P B paper (21 s of the degrees of size8 s of air permeability)

(Embodiment 42)

NBS Ricoh Co.Ltd. make; the NBS facsimile-posting paper 45K (11 s of the degrees of size45 s of air permeability)

(Embodiment 43)

; by Honshu Paper Co. Ltd. and \*\*\*\*\* (12 s of the degrees of size21 s of air permeability)

(Embodiment 44)

Ricoh Co. Ltd. make; the paper source PPC sheet type S (22 s of the degrees of size13 s of air permeability)

(Embodiment 45)

Xerox Corp. make ;P Paper (24 s of the degrees of size19 s of air permeability)

(Embodiment 46)

Xerox Corp. make; the multi-ace (25 s of the degrees of size17 s of air permeability)

(Embodiment 47)

Xerox Corp. make; Xerox4024 paper (32 s of the degrees of size21 s of air permeability)

Printing evaluation was carried out to the following recording medium using each ink given in Embodiment 24.

(Embodiment 48)

Xerox Corp. make; the Xerox paper R (8 s of the degrees of size20 s of air permeability)

(Embodiment 49)

A product made by AUSTRALIANPAPER (Australia); REFLEX (25 s of the degrees of size4 s of air permeability)

(Embodiment 50)

NBS Ricoh Co. Ltd. make; NBS facsimile-posting paper 90K (60 s of the degrees of size68 s of air permeability)

(Embodiment 51)

Canon company make ;P B paper (21 s of the degrees of size8 s of air permeability)

(Embodiment 52)

NBS Ricoh Co. Ltd. make; NBS facsimile-posting paper 45K (11 s of the degrees of size45 s of air permeability)

(Embodiment 53)

; by Honshu Paper Co. Ltd. and \*\*\*\*\* (12 s of the degrees of size21 s of air permeability)

(Embodiment 54)

Ricoh Co. Ltd. make; paper source PPC sheet type S (22 s of the degrees of size13 s of air permeability)

(Embodiment 55)

Xerox Corp. make ;P Paper (24 s of the degrees of size19 s of air permeability)

(Embodiment 56)

Xerox Corp. make; multi-ace (25 s of the degrees of size17 s of air permeability)

(Embodiment 57)

Xerox Corp. make; Xerox4024 paper (32 s of the degrees of size21 s of air permeability)

[0180]

[Table 1]

[0181]

[Table 2]

[0182]

[Effect of the Invention]According to this inventionit is based on neither colorant nor a paper typeexcel in perviousness and drying propertyand can provide the aqueous recording liquid by which image quality -- there are few blots -- was improvedand still such recording inkSince phase separation is not carried outeither and neither condensation nor thickening occursit is suitable for using for the regurgitation and the record method which makes it disperse and forms a picture in a recording medium as droplet from a detailed delivery. And the recording equipment possessing the recording fluid cartridge which accommodated the recording ink which is the high osmosis characteristic in this way andwhose high reliabilitysafetyand outstanding picture characteristic become possibleand this cartridge can be provided.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1]The outline front view showing the example of composition of the serial type ink-jet recording device which carries the ink cartridge which accommodates the recording ink which applied this invention is shown.

[Drawing 2]The appearance perspective view of the ink cartridge before loading recording equipment is shown.

[Drawing 3]The right sectional view of an ink cartridge is shown.

[Drawing 4]The appearance perspective view of the recording unit united with the recording head is shown.

[Explanations of letters or numerals]

1 and 2 Side board  
3a main support guide rod  
5 Carriage unit  
6 Head (ink jet head; recording head)  
6a Regurgitation side  
7y7m7cand 7k Ink cartridge  
8 Horizontal-scanning motor  
11 Timing belt  
12 Bottom plate (subframe)  
13 and 14 Subframe  
15 Transportation roller  
16 Paper  
17 Vertical-scanning motor  
18 Gear  
19 Gear  
21 Subsystem  
22 Capping means  
23 Holder  
24 Link member  
25 Engagement part  
26 Suction tube  
27 Suction pump  
28 Wiper blade  
29 Blade arm  
30 Recording unit  
31 Electrode  
32 Nozzle  
41 Cartridge body (ink tank)  
42 Ink absorber  
43 Case  
44 Top-cover component  
45 Ink feed opening  
46 Seal ring  
47 Atmosphere release mouth  
48 Slot  
50 Cap member  
55 Seal member (film state seal member)

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